CLEANING WATER

Student Section Student Name _____

This lesson challenges you to create and test a water filtration system.

During this lesson, you will

- design and build your own water filtering system.
- collect data to compare water before and after filtration.
- develop a conclusion based upon the results of this activity.
- compare individual results to class results to look for patterns.

Problem

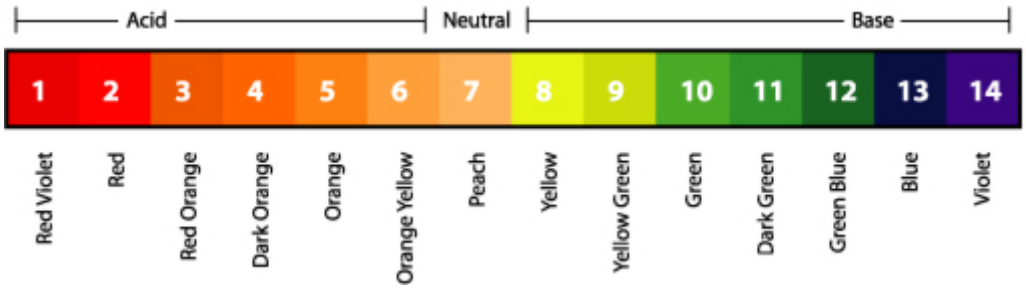
What can I do to make clean water?

Observation

The astronauts onboard the International Space Station (ISS) join those of us on Earth in the recycling effort. This recycling is different from that which may take place in your home or school. The astronauts recycle their water. This includes the moisture they exhale and sweat, as well as the water they use to shower and shave. These wastewaters are purified and then used as drinking water.

The ISS uses filtration and temperature sterilization to ensure the water is safe to drink. Water is checked often to ensure it meets the water quality requirements and monitored closely for bacteria, pollutants, and proper pH. The pH scale ranges from 0 to 14 and is a tool used by scientists to measure the strength of an acid or base. Proper pH balance of 7 is important to a human body.

pH COLOR CHART



pH SCALE (Summary)

Measure	Type	Examples
Below 7	Acid	citrus juices such as lemon, orange, or lime sodas such as cola
7	Neutral	pure, clean water
Above 7	Base	toothpaste, baking soda

Public water systems have to meet a pH level of 6.5 to 8.5. The ISS water is required to be within the range of 6.0 to 8.5. The recycled water on the ISS is sterile, and there is no odor or bad taste.

Water recycling will be imperative for long-duration missions such as on the ISS or possible trips to the moon and Mars. A spacecraft on a lengthy trip to the moon and Mars would be limited to the amount of water it could carry because of weight restrictions.

In this activity, you will create and test a water filtration system.

Use the first column of this KWL chart to organize your observations about water recycling and filtration. Brainstorm with your group what you want to know about water recycling and filtration, then list in the second column of this KWL chart.

KNOW	WANT TO KNOW	LEARNED

Hypothesis

Based on your observations, answer the “problem question” with your best guess about what will happen. (What can I do to make clean water?) Your hypothesis should be written as a statement.

My hypothesis: _____

MATERIALS

Per group

- safety glasses
- 1 water filtering system structure (2-liter bottle with the bottom cut off and cheese cloth secured around the top)
- 3 filtration materials (to be chosen during the test procedure)
- 5 litmus paper strips
- pH color chart
- 1 metric ruler
- 3 large, clear plastic cups with a hole punched just below the rim
- 3 paper plates
- 1 metric liquid measuring cup
- 500 ml of clean water
- 500 ml of gray water

SAFETY

Review your classroom and lab safety rules.

- Put on safety glasses when instructed.
- Use wafting when observing odor.

Test

1. Put on your safety glasses.
2. Place the bottle upside down with its mouth over the clear plastic cup to catch the filtered water. (See diagram of the Cleaning Water Filtering System.)
3. Choose three slips of paper from the teacher. The items written on these papers will be the materials you layer in your water filter. If you choose a “free choice” slip, you and your group may choose what material to use for this filtration layer.
4. Gather your filtration materials on the paper plates; one on each plate. As a group, decide the order in which to layer your materials.
5. Fill the bottle with the first filtering material to a depth of 5–8 centimeters (cm).

   Note: Coffee filters and cotton balls will need to be packed down.
6. Place the second filtering material to a depth of 5–8 cm on top of the first one.
7. Place the third filtering material to a depth of 5–8 cm on top of the second filtering material.
8. Obtain 350 ml of clean water. Observe the properties of the water before you filter it. Use the wafting technique to smell the water. Measure the pH of the water with litmus paper and compare it to the pH color chart. **Collect data and record** your observations on the Cleaning Water Data Sheet. Remember smelling rules in the science lab and do not taste.
9. Run clean water through your water filtering system to make sure it will allow water to flow through.
10. While you are waiting for the clean water to run through the water filtering system, draw and label your diagram to match your filtration system.
11. Once the clean water has gone through the water filtering system, replace the clear plastic cup with a new one. If the water is sandy, it should be disposed of outside. Otherwise, it can be disposed of in the sink.

12. Get 350 ml of gray water. Observe the properties of the water before you filter it. Check the odor of the water. Measure the pH of the water with litmus paper and compare it to the pH color chart. **Collect data and record** your observations on the Cleaning Water Data Sheet.
13. Run the gray water through your water filtering system. Observe the properties of the water after it has been filtered once and **record** your observations on the Data Sheet. Measure the pH of the water with litmus paper and compare it to the pH color chart. **Collect data and record** your observations on the Cleaning Water Data Sheet.
14. Replace the clear plastic cup with a new one. Pour the filtered water back into the water filtering system.
15. Filter the water again. While the gray water is running through the water filtering system, discuss in your group what each layer in your filtration system did to the water.
16. Observe the properties of the water after it has been filtered for the second time. Check the odor of the water. Measure the pH of the water with litmus paper and compare it to the pH color chart. **Collect data and record** your observations on the Cleaning Water Data Sheet.

Study Data

After taking all measurements, study the data on the Cleaning Water Data Sheet and answering the following questions.

1. What happened to the water as it passed through the different layers of the filter? What changes occurred to the properties of the gray water as it was filtered (pH, appearance, odor)?

2. Compare your filtered water to the clean water. Did your gray water become “clean”? What properties told you it was or was not “clean”?

3. Does this data support your hypothesis? Why or why not?

4. If you could build a water filtering system by using any of the materials available in the class, which three materials would you use and in what order would you layer them? Why?

5. Based on your findings, what would you suggest to NASA scientists and engineers designing filtration systems and water recycling methods?

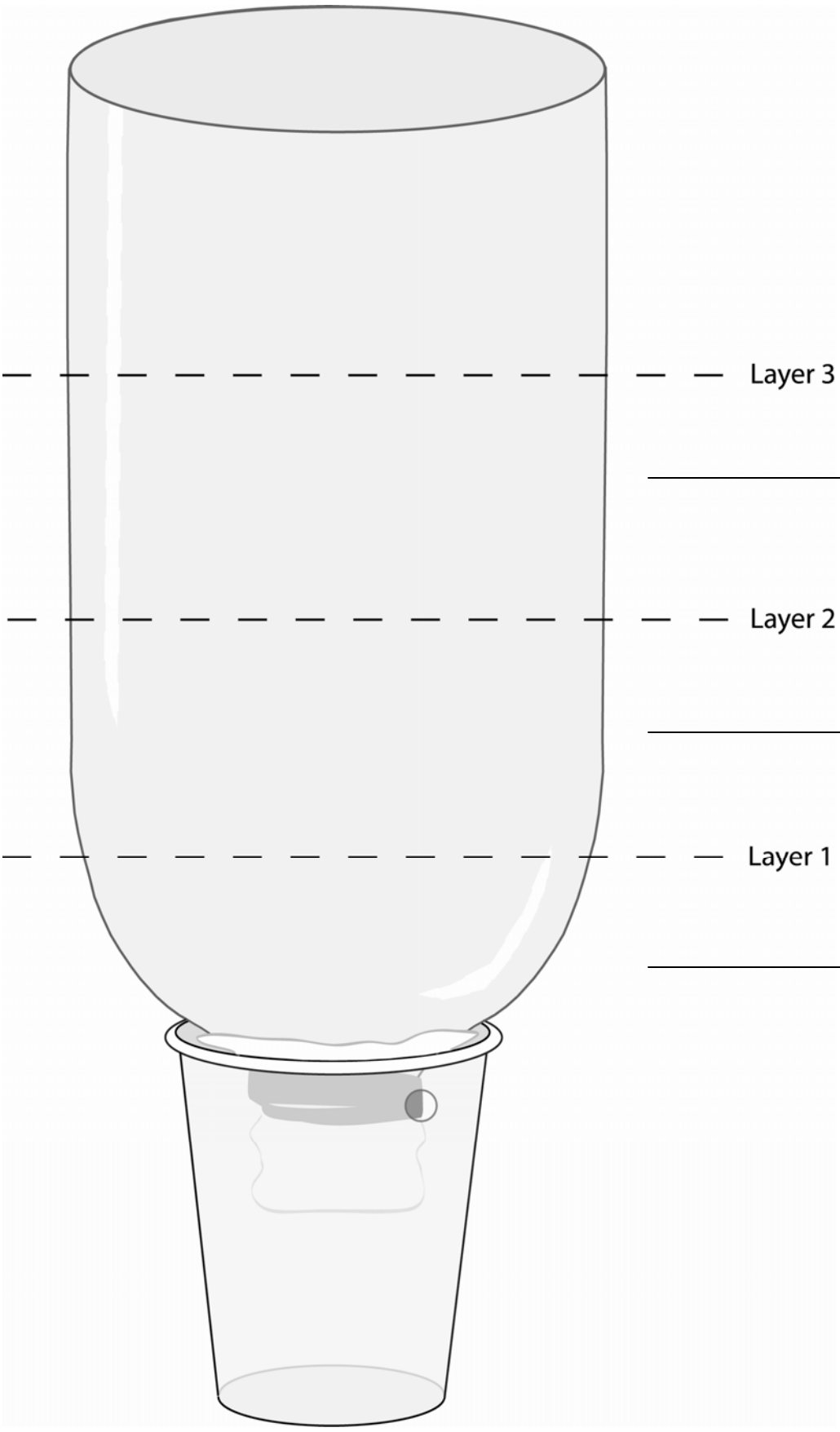
Conclusion

- Update the LEARNED column in your KWL chart.
- Restate your hypothesis and explain how the results do, or do not, support your hypothesis.

Cleaning Water Data Sheet

Properties	Clean Water	Gray Water Before Filtering	After 1st Filtering	After 2nd Filtering
Odor				
Appearance				
pH				

Cleaning Water Filtering System



Scientific Investigation Rubric

Activity: CLEANING WATER

Student Name _____ Date _____

Performance Indicator	0	1	2	3	4
The student developed a clear and complete hypothesis.					
The student followed all lab safety rules and directions.					
The student followed the scientific method.					
The student recorded all data on the data sheet and drew a conclusion based on the data.					
The student asked engaging questions related to the study.					
The student described at least one recommendation for NASA in the area of water recycling and water filtration.					
Point Total					

Point total from above: _____ / (24 possible)

Grade for this investigation _____

Grading Scale:

A = 22 - 24 points

B = 19 - 21 points

C = 16 - 18 points

D = 13 - 15 points

F = 0 - 12 points